As one of the commenters acknowledged, at worst, CELSAT's Pioneers Preference request and petition need only be stayed pending the filing of its application. LQSS, PP Comments, p. 10, fn. 8.

"CELSAT is Not an Applicant:"

LQSS argues that the existing regulatory constraints make no provision for an HPCN system concept (LQSS, RM p.2) and that CELSAT has not filed an Application as they state to be required (LQRM p.2). These two observations explain each other. CELSAT fully recognizes that there is no place in the present rules for an HPCN of the type proposed. To file an application at this time would be futile if not impossible since there is no provision in the rules for such a system. CELSTAR has instead, chosen to disclose to the commission and to the community, the enormous advantages in efficiency, service, and cost that could result from such a system, and to petition the commission for the regulatory changes necessary to provide the basis for an application.

LQSS's statement that a Pioneer's Preference could be *"used"* only by an applicant is literally correct but misleading. In fact the Pioneer's Preference rules (Sec 1.402) specifically provide for the present approach of petitioning for rulemaking, concurrent with application for pioneer's preference, looking to application at a later time, directed specifically to the petitioned-for-rules *when and if* they are enacted. Concurrent application for spectrum is specifically not a requirement for the Pioneer's Preference but an alternative to the petition for rulemaking. (Section 1.402b of rules).[36]

> "Now, two months later, 10 months after applications for use of the RDSS spectrum were cut-off, CELSAT has still not filed an application. Not only does this fact raise questions about CELSAT's bona fides and the truthfulness of its representations, but also it makes CELSAT's pioneer's preference request defective." LQSS Opposition, PP. p. 9; also, fn. 6.

And also:

> "Indeed, CELSAT has apparently still has not filed an application to accompany its petition and pioneer's preference request, even though such an application was to have been filed concurrently therewith." TRW Petition to Dismiss or Deny PP p. 5.

[36] Notwithstanding that CELSAT's Request is not fatel for lack of an application, given the controversy surrounding this situation, CELSAT intends to file its application fairly shortly.

GTE, Motorola, TRW, and LQSS claim that insufficient information is available with which to evaluate the CELSTAR system. (This claim is not echoed by AMSC.) In point of fact, CELSAT included technical information well beyond what appears to be the norm in those proceedings, and none of the above were able to offer any technical analysis or other data to refute a single item of the extensive technical material presented.

All that GTE, Motorola, TRW, and LQSS have been able to offer these proceedings is a sort of "when did you stop beating your wife" argument. CELSAT's CELSTAR system is thoroughly described in its Petition for Rulemaking. The system, its major parameters and its performance are described in the body of the text to CELSAT's Petition as well as its Appendices A, B, C, D and E.

Appendix A presents an overview of the CELSTAR system. All subsystem elements are defined in sufficient detail to permit an understanding of the concept and analysis by competent technical people skilled in the art of mobile satellite and cellular systems.

Appendix B depicts, in painstaking detail, CELSAT's HPCN radio frequency plan and presents further technical details of our unique hybrid system concept. gain, the technical silence must be taken as acquiescence rather than accepting the feasible excuse that "insufficient information is given".

Appendices C and D present thorough analyses of interference and compatibility with other systems. The flexibility and ability of CELSAT to accommodate RAS and Glonass are shown to be well beyond that of the alternate proposals. Once again, the above are silent with regard to this analysis.

Appendix E presents the results of a very thorough analysis of the entire CELSTAR system. This analysis has been painstakingly undertaken over the last several years. It is fundamental to CELSAT's technical case, and can be readily understood and commented on by competent technical personnel skilled in communications system analysis.

No experiment has been completed to prove the feasibility of the system."[37]

The feasibility of the CELSTAR system has been well established by CELSAT itself (as demonstrated in its Petition for Rulemaking), has been reviewed by the U.S. Space Command (see SUPPLEMENTAL APPENDIX D, General Stewart's (retired) letter), among other organizations. One might now infer acceptance of its technical feasibility by the inability of the respondents to present any sort of technical case to the contrary.

Among others, CELSAT's CELSTAR system utilizes two major elements:

- CDMA for use with either ground cellular or spacecraft; and
- A network controller which permits the smooth and seamless operation of CELSAT's proposed HPCN.

CDMA technology is well known having been used for over three decades by the military. GPS is a notable example of a space-based CDMA system whose fully tested performance equals or exceeds performance predictions by CELSAT's founders in the late 1960's. Many CDMA systems have been fielded in the ensuing decades and its design parameters are well known. More recently, extensive field testing of Qualcomm's CDMA system in a cellular environment has been completed by a dozen or so organizations.

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[37] See, e.g. TRW:

"In this instance, CELSAT has not provided the Commission with a feasibility study showing in its initial preference request, and has not even applied to the Commission for experimental authorization. In other words, CELSAT has offered no definitive data that would help to establish, much less confirm, the technical viability of its CELSTAR proposal. Thus, CELSAT's concept remains unproven, and its request for a pioneer's preference must be rejected. [Footnote omitted.] TRW Petition to Dismiss or Deny p. 15.

Test results match CELSAT's analytical predictions. No further testing is required to demonstrate the feasibility of CDMA for this use.

Some of CELSAT's founders have been involved in satellite design since the early 1960s. Communication satellite performance prediction is an art well establish in the 1960s and repeatedly verified in the 1970s, 1980s, and now the 1990s. An experimental license and resultant ground based experiment are not needed and are hardly likely to shed further light on this situation.

Finally, the network controller is a very straight forward technical concept with no elements requiring demonstration to prove technical feasibility.

B. CELSAT's Rule Making Petition Is Viable

Opponents point out that any rules for a new or existing service must follow from a petitioner's proposal and lend themselves to the grant of a preference and a license to the innovating party. They then attempt to show either that CELSAT's initial spectrum proposals are unavailable for CELSAT's proposed use, or that its concept is so different from any other proposed use of the requested spectrum that HPCN has to be dismissed, considered alone, or at least outside any existing proceedings.[38] Their position follows:

> "Since both proposals in the CELSAT petition are not viable, there is no legitimate reason to give its Petition any further consideration. When the Commission dismisses the CELSAT Petition for Rulemaking it must also dismiss the CELSAT request for a Pioneer's Preference. This is because, under FCC policy, CELSAT cannot qualify for a Pioneer's Preference unless it submits a

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[38] See, e.g., Motorola:

The appropriate treatment of CELSAT's is to dismiss it. CELSAT may,file it petition as CELSAT's comments in the WARC-92 proceeding to follow. . . . Moreover, to the extent CELSAT is proposing a "hybrid" cellular/satellite mobile system, CELSAT also has an opportunity to file in the Commission's rulemaking proceeding proposing to allocate spectrum for emerging technologies (ET Docket 92-9). In short, there are a number of proceedings where CELSAT can present its ideas without the Commission having to institute a new rulemaking proceeding in order to have CELSAT's proposal receive full consideration. MSC, RM p. 3.

> rulemaking petition requesting either an allocation of spectrum or an amendment of the existing rules to accommodate the proposed new service or new technology." LQSS RM, p. 5.

With respect to the contention that CELSAT cannot be awarded a pioneers preference without having filed a petition for rulemaking, LQSS is clearly wrong.

First, CELSAT has filed the necessary petition, and it is viable.[39]

Second, however, the Commission has recently clarified its Pioneer Preference policy by confirming that it will not be necessary to file such a petition where one is already pending. This clarification is recognized by TRW, but, in anticipation of the obvious response to LQSS' position above, TRW seeks to prevent any chance that CELSAT might be bootstrapped into the related RDSS rule making proceedings initiated by others:

> "While CELSAT is generally proposing services similar to those proposed by TRW and others in pending applications and rulemaking petitions, it may not rely on the pendency of such petitions in an effort to secure consideration of its pioneer's preference request. CELSAT's proposal would require rule changes incompatible with those proposed by other parties seeking to use the RDSS-band frequencies, and therefore its preference request may not be considered in conjunction with any of the rulemaking requests currently pending before the Commission. TRW Petition to Dismiss or Deny p. 9.

TRW's position would amount to a denial of CELSAT's right to administrative due process to participate in and benefit equally from the formulation and adoption of new rules of "general applicability". [40]

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[39] CELSAT admits that no spectrum band in the United States has been allocated for operation of an integrated satellite and ground cellular system in the same spectrum band. To CELSAT's knowledge, no firm has previously proposed such a system. For CELSAT to deploy its complete HPCN system requires, at a minimum, rule changes allowing ground cellular systems to operate in the same spectrum band as mobile satellites. Amendment of Parts 2, 22 and 25 of the Commission's rules clearly apply to avoid potential interference and allow ground and space cellular operation. These rule changes follow directly from CELSAT's proposal.

[40] Cf., the position of LQSS, RM, p. 13, fn. 11.

Further, as pointed out above, the CELSTAR HPCN system comes in two parts -- a space part, functionally resembling but far superior to other proposed systems in the same bands, and a ground part which never operates on the same subbands simultaneously as are used by the space part. Thus, CELSAT's space-based proposal could very easily be operated under many of the rule changes being proposed by the others, including changes which would affect the use of the RDSS bands for MSS voice service and any relaxation of the power flux density limitations.

To the extent that the pending rule proposals of other applicants result in codifying a spectrum sharing scheme for spread spectrum, as CELSAT's contribution in the form of its sharing proposal demonstrates, CELSAT's requirements would be very compatible with the rule changes required by other spread spectrum users.

Therefore, there is no basis for dismissing CELSAT's Request for Pioneers Preference for lack of a relevant rule making proposal. The correct solution to this problem is to consolidate CELSAT's Petition with those of the others, and for the Commission to issue a single Notice of Proposed Rulemaking reflecting all pending proposals.

Unavailability of Spectrum:

As discussed above with respect to the cut-off issue, CELSAT is not out of the running for access to the RDSS L/S-Band. Thus, the disposition of this band is still relevant to CELSAT's Preference request. But in addition, CELSAT proposed that the Commission allocate 37 MHz in the S-band at 2110-2129 MHz for its downlink and 2410-2428 for its uplink, based upon the Commission's proposal to the 1992 World Administrative Radio Conference (WARC- 92) that these bands be used for generic mobile satellite services. See, An Inquiry Relating to Preparation for the International Telecommunications Union World Administrative Conference, (WARC-92 Inquiry) 6 FCC Rcd 3900 (1991). However, these bands were not allocated for MSS on an international basis at WARC-92, and, therefore it is argued that "because neither of the alternative frequency plans proposed by CELSAT is capable of being effectuated, its rulemaking request is moot and must be dismissed without further consideration." TRW Petition to Dismiss or Deny p. 8; LQSS Opposition, PP. p. 9.

Apparently, however, the parties are not sure of their position in this respect, for they acknowledge that the Commission could, indeed, elect to open the requested bands for HPCN use domestically, irrespective of the WARC-92 outcome:

> "While the Commission could adopt table of allocations inconsistent with the WARC, any U.S. licensed satellite operating at those frequencies for mobile satellite service would have to cease operation immediately in the event that any interference were caused to any entity utilizing those bands in the appropriate manner. Therefore, a modification of the Commission's table of allocations to allow such use . . . only on a non-interfering basis would be impractical and ill advised . . . ." TRW RM p.13-14; also, TRW Petition to Dismiss or Deny p. 6-7; LQSS Opposition, PP. p. 9.

Also,

> "Considering the legal and regulatory constraints that would govern these frequencies, CELSAT is not likely to find them acceptable. For this reason, it appears that CELSAT's proposal in its rulemaking petition is now unjustified and undesirable." LQSS RM p. 3-4.

CELSAT anticipated this possible outcome and requested in its petition that the Commission do just that -- i.e., allocate Band A for HPCN use domestically.[41] As for whether the Band A alternative would still be acceptable to CELSAT in view of the WARC outcome, CELSAT needs a reasonable opportunity to make this assessment for itself; but for the time being, CELSAT believes that Band A is viable and therefore its request is still alive.[42] Meanwhile, the opponents have attempted to prejudge this decision for CELSAT, and thereby have its Petition declared dead.

Finally, as discussed below, CELSAT is prepared and frequency agile enough to operate in several different alternative bands. It has proposed yet other alternatives in this Reply. Moreover, irrespective of whether the Commission opts for CELSAT's initial proposed bands, it is always free to adopt something other than

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[41] See, CELSAT Petition, EXHIBIT 2, p. 2-2.

[42] Given its far superior capacity, flexibility and low cost, neither the Commission nor the opponents should underestimate CELSAT's ability to appease other existing users of these bands to relocate in exchange for functional capacity on or even equity in the CELSTAR system.

what has been proposed. Such a course has, indeed, been anticipated in the Commission's Pioneer Preference rules, and would not affect the petitioner's right to a Preference grant.[43]

C. Terrestrial Rules

Only one party has complained that CELSAT's Petition is defective for failure to propose rules which would be necessary to accommodate its terrestrial system. LQSS RM p. 11-12. First, again because the CELSAT HPCN system comes in two parts, either of which can be operated without the other (but under the jurisdiction of one common network controller), the failure to address all possible necessary rule changes required by the proposed ground segment of the HPCN system does not affect CELSAT's interest in being considered now for a preference and a license for the space-segment. Nor does it prejudice the rights of the other applicants for the RDSS bands for *space use only*.[44]

Second, again because of this space-ground independence or separability for rule making purposes, it seemed appropriate to CELSAT to let the rule changes required for the ground system evolve with the proceeding. Since the heart of HPCN is the satellite segment (although the capacity is in the ground segment), it should be possible and even desirable for the Commission to direct its attention first to the satellite rules. Also, because of the possibility that the emerging PCN rules might also be relevant, it would be desirable to let those rules evolve before attempting to detail a microcellular scheme unique to HPCN.[45]

In any event, for all practical purposes CELSAT submits that in all but two respects (addressed, *infra*) its proposed HPCN ground system would operate comfortably and fittingly under the existing scheme of the

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[43] See, Report and Order, 6 FCC Rcd 3488, at 3495.

[44] It is worth noting that while CELSAT served a courtesy copy of its Petition on the CTIA, neither the association nor any member of the cellular industry filed any opposing comments.

[45] See, e.g., GTE Comments, RM, at p. 3.

Part 22 rules currently applicable to both wireline and nonwireline cellular systems. Thus, the required additional rule changes would be minor.

"Primary" and "Secondary" Sharing of HPCN Ground Cells

However, based on the comments filed in this proceeding CELSAT now recognizes that there would be considerable benefit in expanding the level of competition possible on the HPCN ground segment to include multiple ownership and "secondary" licensee possibilities on the ground segment.[46]

Specifically, CELSAT is proposing that the Commission adopt a rule provision in Part 22 which would permit maximum latitude for the regional ground cellular markets described above to be separately "licensed" on a secondary basis to an entity other than CELSAT, as the primary space segment HPCN licensee.[47]

Under such an approach to re-licensing the subbands allocated for HPCN ground use it would still be required, for all the reasons stated in CELSAT's Petition, for the HPCN space/ground network controller -- essential to both the space and the ground system operations -- to be under the nationwide operating and administrative jurisdiction of one HPCN spectrum licensee. (Petition, pp. 41-45.)

It is not a technical requirement that the primary HPCN licensee actually construct, own and operate all of the terrestrial service regions. It must be anticipated, however, that the primary licensee for the HPCN spectrum allocation (whether shared or not in space) might also be a secondary license for at least

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[46] This is not a proposal to "share spectrum subbands allocated for ground use. For the reasons explained in its Petition, it is still absolutely essential that there be one operator in charge of the network controller which, in turn, regulates use of both the space- and the ground subbands.

[47] The "primary" HPCN licensee is the applicant for the space-based HPCN spectrum which is aproposing to offer the full HPCN service, including taking responsibility for establishing and operating the network controller, both for its own needs as well as those of the other secondary ground cell (and microcell) licensees.

one or more of the "regional clusters" or terrestrial market areas. This is to be expected for both technical and economic viability reasons.

Accordingly, CELSAT requests that the Commission amend Part 22 of its rules to provide for such "secondary" terretrial license status -- i.e., a license to build, own and operate an HPCN regional ground system, subject to compliance with the rates, terms, conditions, technical standards and operating parameters established by the HPCN satellite licensee, CELSAT.[48] Further, the Commission should establish procedures by which it would accept applications and grant licenses for such regional ground cellular systems.[49]

Finally, CELSAT believes that HPCN microcells could also be licensed, constructed, owned and operated independently of either the secondary ground cellular or primary HPCN space segment licensees, subject to similar terms of interconnection, etc. reguired of the other ground operators. An HPCN-based microcell or PCS/PCN system is to be distinguished from a secondary regional ground cellular system in that the former will be limited to one or two proprietary cell sites, while the latter will be authorized to operate ground cells throughout a multistate region. In general, such proprietary microcells will be located outside the coverage areas of the ground cell licensees (for technical reasons), unless owned by the secondary licensee itself. Microcells typically might be used at remote military sites or campus-like facilities in rural areas away from secondary ground cell systems.

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[48] Such an arrangement would not be as complicated as it might appear. CELSAT anticipates that the details of the interconnection and operating agreements would be worked out among the HPCN space and ground licensees, and reflected in contracts rather than Commission rules.

[49] The geographic size and locations of the "regions" would have to correspond for technical reasons to the HPCN clusters technically and geographically defined by the primary HPCN licensee. (Petition, pp. 12-15). There would be about 10 - 14 separate regional terrestrial "clusters" or markets. Of course, CELSAT requests consideration to among these new licensees.

D. CELSAT Has Expended Considerable Effort And Has Made A Contribution Toward Advancing The Art

If CELSAT's contributions to CELSTAR's design are trivial and obvious as many opponents imply,[50] why has no other proposal taken advantage of the "obvious" potential order of magnitude improvements in the most important factors of capacity, spectral efficiency, and cost per unit traffic? Admittedly the CELSTAR effort cannot yet be compared with some of the competing efforts in terms of the weight of documentation. Judged by bottom line results, however, we dare say that the CELSTAR system will follow a model for others to copy in years to come. That is a true pioneering role.

The effort expended by CELSAT in developing its HPCN system and concept to a position where it could file for a Pioneers Preference has been substantial in time and in founders resources. The thoroughness, scope quality and detail of the materials provided in its FCC filings to date attest to this.

Obviously, significant breakthroughs in the radio satellite field do not occur readily or easily. CELSAT's founders began their efforts in early 1989 and its first application for a U.S. patent was filed in March, 1990. Many highly qualified professionals have participated in CELSAT's planning and development over a period of three years.

The quality of the product disclosed to date speaks for the significance of the underlying efforts. CELSAT's CELSTAR® system represents a quantum leap over all competition in terms of capacity, frequency efficiency, low cost, low subscriber power, features and functionality to the end user. These

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[50] One commenter questioned whether CELSAT has the technical capability to execute CELSAT's HPCN plan, and suggested that maybe CELSAT has not expended enough effort to warrant a pioneers preference. GTE Comments, Opposition, PP p. 14. CELSAT submits that its resources and efforts meet and exceed the expectations of the Commission's pioneers preference scheme. [cite] Another argues that "CELSAT has not demonstrated that . . . its efforts were significant in developing the technology utilized. . .." TRW Petition to Dismiss or Deny p. 13.

include high quality voice, low to high speed data and fax, paging, accurate and timely position determination, broadcast features, and compressed video.

In terms of human labor and other monetary resources, CELSAT's efforts are again significant. A number of highly motivated and highly competent individuals labored long and hard to develop a detailed architecture for a system that represents a break through in performance over any other proposed system. Over thirty professionals have been involved in CELSTAR's development to date. Although a monetary measure cannot truly value these efforts, in monetary terms the value now approaches two million dollars.

CELSAT is therefore eligible, by its efforts to date, for a preference.

VI. LINGERING SPECTRUM ISSUES

When CELSAT originally filed its petition for Rule Making and its request for a Pioneer's Preference, the World Administrative Radio Conference (WARC) proceedings had not begun. The outcomes of the WARC proceedings were somewhat different from those anticipated by most U. S. Firms. WARC did allocate additional MSS spectrum, which has opened up new spectrum bands for potential deployment of CELSAT's system.

The specific bands identified by WARC for mobile satellite service on a primary or secondary basis worldwide or in region 2 include 1492-1530 MHz; 1610-1626.5 MHz; 1675-1710 MHz; 1930-2010 MHz; 2120-2200 MHz; 2483.5-2520 MHz; and 2670-2690 MHz. It is believed that CELSTAR could also readily operate in the bands utilized by INMARSAT, specifically at 1530-1544 and 1625.6 - 1645.5 MHz.

Given the recent nature of this development, and the due date of this Reply, CELSAT has not had enough time to adequately evaluate these bands for their suitability in accommodating CELSAT's system.

However, CELSAT's system could generally operate economically in any spectrum band between 1000 MHz and 3000 MHz as long as there was adequate total spectrum, sufficient separation between transmit and receive bands and minimal interference from other users.

CELSAT would willingly work with the Commission to establish rules for CELSAT's use of these bands provided they could be available on time and not require costly and/or speculative relocation of existing licensees. In this connection, and in contrast to virtually all other applicants whose spectrum requirements present a similar need to possibly relocate existing users, the very high capacity, versatility, ubiquity and variety of services available with CELSAT's proposed HPCN put it in position to offer many such users an incentive which no others are able to offer -- namely, a functional substitute for their existing service or facility.

CELSAT's proposal does not create the interference concerns raised by other RDSS-band applicants. It proposes to avoid interference to RAS facilities by dividing the RDSS uplink band into subbands and not using the lower 3.75 MHz of the band either in the vicinity of or when RAS facilities are operating. Interference with Glonass has been discussed at length in CELSAT's Petition at Appendix D.

Meanwhile, it has been asserted that future amateur satellites, both for low Earth orbit and those for real time communications, will increase significantly the use of the 2400-2450 MHz band such that a primary allocation of that band, or any portion of it, for uplink purposes as proposed by CELSAT, would, due to incompatibility, result in a profound disruption of development of Amateur Satellite Service systems. American Radio Relay League, p.5.

In response, CELSAT admits that it needs more technical information on the link characteristics of the amateur satellite service systems and that the Leagues concerns are well taken. While CELSAT will conduct a thorough review of any such interference potential before filing an application for use of this band, CELSAT believes that it will find its planned use of the subject band being relative to the ASRL's concerns.

Other commenters made some mis-observations such as ". . . CELSAT has failed to demonstrate that its system could operate without causing interference to or receiving interference from existing users of the bands" or "CELSAT appears to be requesting the relocation of other users of the bands, such as radio astronomy and radio navigation systems in the RDSS uplink band." AMSC Opposition, PP p. 2, fn. 2-3; 7. CELSAT's Petition was clear on these points, and it is apparent that AMSC simply did not read the extensive interference analysis included with the Petition. (See, Appendices B and C.) CELSTAR, of course, will not require any relocations from the L/S-Band, and it offers the Commission very excellent assurances that it will neither interfere with Glonass nor the radio astronomy uses. Id.

The Committee on Radio Frequencies ("CORF") of the National Academy of Sciences-National Research Council, which represents the interests of radio scientists, including radio astronomers, and researchers involved in remote sensing, wildlife telemetry, and meteorological research., appeared to appreciate CELSAT's potential ability to avoid interference to its constituents:

> "CELSAT proposes to avoid such interference by not assigning frequencies below 1615 MHZ to portable/mobile terminals in affected areas during period of radio astronomy observation. CORE agrees that this method of system operation could avoid interference to radio astronomy, but only if certain conditions could be assured:
>
> > - the specified protection radius around observatories must be adequate to protect them from harmful interference from terrestrial and airborne terminals;
> >
> > - the operation of the frequency assignment sub-system of the control center must be designed to determine, and keep track of, the location of all portable/mobile terminals with sufficient accuracy to prevent the assignment of RA frequencies to terminals within the specified protection radius of an observatory through-out the entire period of operation of such terminals;
> >
> > - the control center must be able to detect rapidly, and to deal effectively with, portable/mobile terminals operating in the system which have been purposely altered so as to increase their equivalent isotopically radiated power above the design level. CORE p.3.

CELSAT submits that it believes that its system will meet all of CORF's conditions.

CORF also points to a concern that "CELSAT's proposal to use the band 2483.5-2500 MHz for space-to-Earth transmissions in the Mobile Satellite Service creates a potential problem for radio astronomy observations, since the second harmonic of those transmissions would fall in the band 4967-5000 MHz. " CORF p.8. CORF believes that it is feasible, and apparently Ellipsat and other applicants have agreed, that RDSS operators should be required, to provide adequate filtering in the satellite, in order to reduce interference to this radio astronomy band to below the levels specified in CCIR Report 224. CORF believes that this same requirement should be required of CELSAT-type systems. Id. Preliminarily, CELSAT will agree to comply.

Finally, related to "lingering spectrum issues" to be resolved, CELSAT would note that to the extent spectrum sharing on a spread spectrum basis, such as with the Gang-of-Four is the Commission's choice, and CELSAT is included within this group an accommodation will have to be made for the allocation of ground cell subbands if they are not provided for within the RDSS L/S-Bands. CELSAT is confident, however, that this requirement can be worked out among the potential sharers, if not before the Commission.

CONCLUSION

CELSAT respectfully urges the Commission to take the following actions:

-- Find that CELSAT's HPCN proposal is not "mutually exclusive" with the proposals currently pending for the RDSS bands, and that CELSAT, as a new company, could not reasonably have made the original cut-off date, and for these reasons waive the RDSS "cut-off" rule and accept, when filed, a non-mutually exclusive application by CELSAT;

-- Alternatively, but for the same reasons, afford CELSAT an opportunity to file a non-mutually exclusive for the RDSS L/S-Bands under a new "cut-off" date to be established by Public Notice, but direct that CELSAT be included immediately as a full participant in any negotiations or negotiated rule making process leading to the sharing of the RDSS bvands;

-- Issue CELSAT a tentative Notice of grant of a Pioneers Preference for a nationwide HPCN system, including a preference for the space segment spectrum, whether on a shared or other baisis, either in the L/S-Band or such other band as the Commission might prefer;

-- Issue CELSAT a tentative Notice of grant of a Pioneers Preference for such secondary ground cellular regional licenses as CELSAT shall request in its an amended Request for Pioneers Preference; and

-- Consolidate the issues raised by CELSAT's Petition for Rulemaking with the others pending with respect to the RDSS bands, including its supplemental rule proposals incldued herein, and issue a consolidated Notice of Proposed Rulemaking.

Respectfully submitted,
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SUPPLEMENTAL APPENDENDIX -- A

SPACE SEGMENT DETIAL

This Appendix supplements certain basic details and other characteristics of the planned CELSTAR® space segment, including mass and power budgets, antennas, orbit preferences, and spacecraft program schedule. It is offered in partial response to those opposition comments which argued that CELSAT has not disclosed adequate technical information to permit an assessment of the technical feasibility of the CELSTAR® system. CELSAT submits, however, that it has provided more than adequate information upon which to make any necessary technical assessments.

CELSAT's Petition, Figure 2 at APPENDIX A, depicts the CELSTAR spacecraft. Additional preliminary characteristics are defined by TABLE I below.

TABLE I

General Spacecraft Characteristics

▪ Spacecraft Dry Mass	4376 lbs
▪ Liftoff Mass	7566 lbs
▪ Number of Satellites	2 Active, 1 Spare
▪ Orbits (Geostationary)	116°W and 76°W Long.
▪ Spacecraft Power (EOL)	4.3 kw
▪ Mission Life	12.5 yrs.
▪ Payload Eclipse Capability	53%
▪ Active S-Band SSPAs	112x7.2/149x5.2 w
▪ UHF Band Redundancy	183 for 112/149
▪ Active K-Band SSPAs	24 x 6 WATTS
▪ K-Band Redundancy	32 for 24
▪ Antenna Size	20 meter UHF Band 2 meter K-Band
▪ Station Keeping	+/- 5.0° +/- 0.05°
▪ Launch Vehicle Options	Ariane 4 or equivalent
▪ Reliability	0.6 for 12.5 yrs.
▪ Stabilization	Three Axis
▪ Antenna Pointing Accuracy	0.05 degrees

Communications with the mobile link is made highly efficient by means of the tightly focused beams from the 20 meter UHF antenna. The Arian 4 launch vehicle is suitable for a satellite of this size and the CS spacecraft fits readily within its shroud as the large antenna dish is folded and telescoped into its launch configuration. However, there exists a good possibility that it could be launched on a less expensive booster, such as an Atlas 2AS, a less expensive Ariane or a Long march.

The spacecraft bus is a conventional 3-axis system which could be readily supplied by one of several different U.S. vendors and at least one European vendor. For example, the GE7000 bus is representative of one capable of performing CELSTAR's mission. Inasmuch as this technology is conventional and well known, it need not be described in this appendix.

The payload will include 183 transponders, of which 112 will be operational using CELSAT's proposed Alternative A S-Band configuration (149 using the L/S-Band), with the rest serving as spares. The spacecraft's estimated mass and power budgets are set out in Tables II and III below.

TABLE II

Satellite Mass Budget

Subsystem	Mass (lbs)
Transponder	1246
Antennas	544
Primary Structure	600
Secondary Structure	100
Attitude Control	177
CR&T	128
Propulsion	329
Power	693
Thermal	169
Harness	152
Balance	30
Subtotal	**4168**
Margin (5%)	208
Total Dry Mass	**4376 lbs**

TABLE III

CELSTAR® Satellite Power Budgets (Watts)

	Equinox Day	Equinox Eclipse	Summer Solstice
Low Voltage Bus			
Communications	00.0	00.0	00.0
ACS	55.5	48.0	65.4
TT&C, (2 Beacons)	59.0	59.0	59.0
Propulsion	2.5	2.5	2.5
Thermal	69.0	70.0	57.0
Power	4.5	4.5	4.5
Subtotal	**190.5**	**184.0**	**188.4**
LVBC Harness Loss	2.3	2.3	2.3
Subtotal	**192.8**	**186.3**	**190.7**
LVBC DC Input Power (90% Eff.)	214.2	182.1	211.9
100 Volt Main Buss			
Communications	3412.0	1824.6	3412.0
Thermal	118.0	24.0	23.0
Power	61.3	46.9	54.9
LVBC Input Power	214.2	182.1	211.9
Subtotal	**3805.5**	**2077.6**	**3701.8**
Harness Loss	19.1	10.4	18.5
Subtotal	**3824.6**	**2088.0**	**3701.8**
Battery Charge Power	250.0	00.0	74.00
Battery Discharge Loss (96% eff.)	000.0	87.00	00.00
Total Load Power	**4074.6**	**2175.0**	**3794.3**
Margin, Watts	234.3	00.0	189.7
Margin, Percent	5.7%	--	5.0%
Total Solar Array (EOL)	**4308.9**	**00.0**	**3984.0**

The CELSTAR satellite payload is a "bent pipe" repeater. The Payload overview block diagram is shown in Figure

1 at the end of this appendix. The payload equipment list with corresponding element weights and power requirements are shown in TABLE IV.

TABLE IV

Payload Equipment List

Component	Quantity	Weight (Lbs.) Per Unit	Weight (Lbs.) Total	Number Power'd	DC Pwr. Per Unit	Total (Watts)
K-Band Antenna	1	35.0	35.0			
L/S-Band Antenna	1	509.0	509.0			
K-Band Input Filter	24	0.2	4.8			
30/4 GHz Receiver	32	0.8	25.6	24	2.0	48
K-Band Rec'r Pwr. Supply	3	3.0	9.0	1	5.0	5
Power Splitters	1 set	16.0	16.0			
Downconverter/Channel						
Filter SSPA	183	1.3	237.9	146	14.0	2044
Transmit Chain Pwr. Supply	30	1.4	42.0	20	11.4	228
Output Filter	146	0.3	43.8			
Input Filter	146	0.3	43.8			
Receiver Assembly						
(LNA + Chnl. Filter + L/S-						
Band	183	1.0	183.0	146	4.0	584
Upconverter)	30	1.0	30.0	20	3.0	60
Receiver Chain Pwr. Supply	1 set	16.0	16.0			
Power Combiners						
4/19 GHz Upconverter/6-WATT	32	1.5	48.0	24	17.0	408
SSPA	24	0.2	4.8			
K-Band Output Filter	1	4.0	4.0	1	12.0	12
Crystal Oscillator Assembly	1	60.0	60.0	1	23.0	23
Local Oscillator Assembly	48	0.5	24.0			
Waveguide R Switch	780	0.37	228.6			
Coaxial T Switch	1 set	150.0	150.0			
Waveguide + Cable	1 set	15.0	15.0			
Brackets + Hardware						
TOTAL			**1790.3**			**3412**

A summary of the satellite key link parameters is contained in TABLE V.

TABLE V

Key Link Parameters

Transponder Configuration	Full -duplex, K-Band - UHF Bent pipe, 10x Freq. Div. Multiplex on backhaul
On-Board Processing	None
U.S. Satellite EVG Capacity (Space segment only.)	56,789 5Kbps voice circuits , Alt. A; 60905 , Alt. B.
UHF Reflector	20 meter deployed mesh
UHF Gain	51.2/47.4 dB, on center; 49.2/46.6 dB avg. over cell
UHF Polarization	RHC
UHF Beams (feeds)	112 extended U.S. coverage (Alt. A); (Alt. B., 149)
Cell Size (miles, mid-CONUS)	204 EW x 248 NS hex major diameter (Alt. A) 174 EW x 212 NS hex major diameter (Alt. B)
Coverage at 10° Min. Elevation	Conterminous U.S., plus Alaska, Hawaii, P.R./V.I.
Transmitter EIRP per Beam, S-Band down-link	58.8 dBW/58.6
L-Band Receiver, G/T	+20.2 dB/°K
K-Band Satellite Receiver G/T	+20.9 dB/°K
K-Band Reflectors, Up/Dn	1.5/2.0 m
K-Band Polarization	RHC
No. K-Band Backhaul Beams, (hub stations)	15-20
K-Band Freq. Multiplex, Up	10 x 13.875 MHz Chnls/Beam + 5 MHz, TT&C
K-Band Freq. Multiplex, Down	10 x 12.75 MHz Chnls/Beam + 5 MHz, TT&C
K-Band EIRP per Beam, Up	44.1 dBW avg.
K-Band EIRP per Beam, Down	37.9 dBW avg.
Down-link BW to Hub	132.5 MHz
Flux Density at Earth	2.4 GHz; -138.6 $dBW/m^2/4kHz$; 194 GHz; -159.4 $dBW/m^2/4kHz$

Antenna and Coverage

The antenna is of a larger size than many deployable antennas used commercially to date, but it represents no major new technical challenges. Several U.S. manufacturers are capable of producing the required antenna to the necessary specifications and reliability, and a competition will be held by the prime contractor to select the best supplier. The rest of the payload consists of conventional "bent pipe" transponder technology, albeit there are substantially more UHF band transponders than are typically launched.

The two CELSTAR® satellites nominally share the continental US (CONUS) on a cell-by-cell coverage basis, with only one satellite actively serving each cell with CONUS divided down the mid-meridian at about 96° W Longitude into two parts for corresponding assignment to each satellite. (This is CELSAT's proposed configuration after launch of the second satellite. Until then, CELSTAR® service will be possible using only one satellite covering the entire US.) However, space cell sharing could also be achieved on an overlap basis, with each satellite serving half of each cell's capacity with exactly the same flux density, satellite power, and resulting circuit capacity. Other hybrid combinations are also possible with this very flexible system.

In the unlikely event of temporary incapacity of either satellite in space, the other active satellite will have enough reserve power to serve the entire CONUS with nearly 60% of its normal system capacity.[1] CONUS capacity, even under such extreme

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[1] CELSAT intends initially to apply for authority to construct two satellites for launch, followed by a third ground spare.

circumstances, would only drop to about 32,000 voice circuits or equivalent capacity (assuming authorized full use of the spectrum) -- still the most effective satellite capability proposed to date.

Figure 2 is a pattern plot of the UHF band 20 meter reflector antenna. The plot represents the directivity resulting when using a cupped crossed dipole circular polarization feed. The primary beam lobe gain is about 51.2 dB at boresight, and secondary lobes are down 20 dB or more.

The primary feed consists of an array of these dipole feeds arranged in a hexagonal grid. The hex pattern is scaled so that adjacent-beam crossover occurs at the -3 dB points, or at 0.43° full beamwidth on the major hex dimension, and at about -2.1 dB on the minor diagonal for the assumed 2.483 GHz downlink. See, Figure 3. This scaling represents a near optimum compromise between edge loss and adjacent cell spillover. Average loss of directionality gain across the cell is -2.0 dB, and average spillover from adjacent cells is -1.8 dB relative to in-cell CDMA noise. Several examples of the resulting beam footprints for satellite at 76° W and 116° W at several US cities and at critical locations were provided at Appendix B, B-3 through B-9 of CELSAT's Petition for Rule Making.

Orbits

CELSAT has completed detailed studies and evaluated the tradeoffs between various orbit possibilities suitable for its hybrid proposal, including LEO, MEO and GEO obits, and selected

GEO as the clear choice notwithstanding that several other potential mobile satellite service providers have selected both LEO and MEO orbits for their respective space-based mobile service. (CELSAT's U.S. Patent coverage is indifferent, however, to which orbit is used.) As shown throughout its Petition, CELSAT believes that its choice of a geostationary orbit not only yields much greater overall space capacity at a fraction of the cost of LEO or MEO systems, but concentrates it over the U.S. market.

The specific orbit locations are determined by the following constraints:

- Full visibility of both satellites anywhere within CONUS
- Good position determination capability anywhere within CONUS
- Ability to serve P.R./V.I. from eastern-most satellite
- Ability to serve Alaska/Hawaii from western-most satellite.

The final orbit locations at 76 W and 116 W Longitude were selected to provide mutual coverage of CONUS with good geometry for position determination while also being able to serve the remote points of Alaska, Hawaii, Puerto Rico and the Virgin Islands.

Estimated Operating Life

The estimated operational lifetime is derived in the normal fashion for geosynchronous communications spacecraft. The elements which ordinarily limit life include expenditure of propulsion fuel; solar array degradation with time; and battery